OPERATIONS AUTOMATION USING 'Tilt LINK MONITOR & CONTROL OPERATOR ASSISTANT

Lorrine F. Lee and Lynne T. Cooper
Jet Propulsion Laboratory
California Institute of Technology
4800 Oak Grove Drive
Pasadena, CA 91109
818-306-6178

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The Link Monitor & Control Operator Assistant (LMCOA) is a knowledge-based prototype system which incorporates several Artificial Intelligence (AI) modules to demonstrate semi-automated monitor and control to support operating the Deep Space Network (DSN) 70-Meter antenna at the Goldstone Deep Space Communications Complex (DSCC). Configuring the 70-Meter antenna and the associated communications and processing equipment (the. "1 ink") to support a spacecraft mission is currently a time-consuming manual process involving operator input of over 100 control actions (subsystem directives) and operator monitoring of over 1000 event notice messages ant] monitor data from several subsystems. The process of configuring a link, referred to as precalibration, is an overhead activity; the time spent in precalibration is time which cannot be spent supporting actual mission operations. Therefore, a major goal of the LMCOA task is to demonstrate techniques that reduce precalibration time, decrease operations overhead, and increase the availability of this valuable and oversubscribed NASA resource.

The LMCOA has three major components: the Temporal Dependency Network (TDN), the Execution Manager (EM), and the Situation Manager (SM). These three components work together to provide a closed-loop, system level control system for precalibration. The TDN is a directed-graph representation of the precalibration process. It is the primary knowledge base for the system. The precal process is represented as a flow chart identifying all of the steps necessary to complete the precal as well as additional information needed to support the control flow. The parallelism inherent in the process is explicitly identified and exploited to improve speed.

The Execution Manager (EM) is responsible for executing the TDN. The execution manager traverses the TDN, dispatches the directives, follows any alternate paths selected by the operator, and handles the parallel execution of the TDN nodes. The Situation Manager (SM) works in step with the execution manager. When a control directive is sent to a subsystem, it is also sent to the SM which keeps a model of both the actual and the expected states of the system. The SM models the subsystems to the device level. When it receives a directive, it updates the expected state of the device models based on its knowledge of the desired effect of the given directive. The SM then compares the actual state of the device to the expected and, after taking system latency effects into account, enables execution of the TDN to continue, or identifies system and process anomalies.

The LMCOA prototype has been tested at the Goldstone DSCC by performing a semi-automated precal using the actual operational equipment. This paper describes the design and operations concept for the LMCOA, and discusses the three major models in detail. It also describes the test approach (compatibility, functionality, and knowledge verification), and the results of operations] field testing.